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Photodynamic nonlinear processes in UV solid-state active media and approaches to improving material laser performance

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Abstract

All known solid-state UV/VUV active media based on the interconfigurational 5d-4f transitions of trivalent rare earth ions in wide-band gap fluoride crystals are solarizable under intense UV/VUV pumping. Active media-specific pumping-induced color centers, on one hand, would absorb the laser radiation and reduce the laser efficiency. On the other hand they also get bleached by the pump laser radiation so that the current value of total intracavity losses is governed by dynamic equilibrium and depends on some active medium microparameters as well as the pump flux and is cavity specific. Presented here are the model of dynamic processes in a UV solarizable active medium under pumping conditions and the new technique of laser experimental data analysis for variable intracavity losses based on this model. It is shown that properly set laser experiment enables us to obtain the necessary active medium microparameters, including the pump excited state absorption and color center absorption of laser radiation cross-sections, photoelectron trapping rate by host lattice defects and their recombination rate. The results of this technique application to the laser experiment analysis for the series of Ce3+:LiYbxLu1-xF4 single crystals are presented.

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Keywords

4f-5d interconfigurational transitions, Fluoride crystals, Photodynamical processes, UV solid-state laser